In the Claims:

Following is a complete list of the claims, as amended:

1.   (Amended) Apparatus for interrogating a sample that exhibits low-frequency molecular motion, comprising:

a container adapted for receiving the sample, the container having both magnetic and electromagnetic shielding;

an adjustable-power source of <u>white or </u>Gaussian noise for directing <u>white or </u>Gaussian noise to the sample, with the sample in the container;

a detector for detecting an electromagnetic time-domain signal composed of sample source radiation superimposed with the directed <u>white or </u>Gaussian noise; ~~and~~

an electronic computer adapted to receive the time-domain signal from the detector, and to process the signal to generate a spectral plot that displays, at a selected power setting of the <u>white or </u>Gaussian noise source, low-frequency spectral components characteristic of the sample in a selected frequency range between DC and 50 kHz<u>, wherein the noise power source adjustment, the sample exposure to the noise and the corresponding sample radiation detection are repeated until approximately optimal peak heights or waveform characteristics are observed in the sample radiation; and</u>

<u>a user interface to assist in identifying components in the sample, or characterizing the sample, based on the spectral plot of the signal from the electronic computer</u>.

2.   (Original) The apparatus of claim 1, wherein the electronic computer includes a signal analyzer that functions to (i) calculate a series of Fourier spectra of the time-domain signal over each of a plurality of defined time periods, in a selected frequency range between 100 Hz and 50 kHz, and (ii) average the Fourier spectra.

3.   (Original)   The apparatus of claim 2, wherein the calculating includes calculating at least five Fourier spectra, each taken over a 1-5 second time-domain interval.

4.   (Original)   The apparatus of claim 1, wherein the electronic computer includes machine readable code operable to:

(i)   store the time-domain signal of the sample over a sample-duration time T;

(ii)   select a sampling rate F for sampling the time domain signal, where F* T is a total sample count S, F is approximately twice a frequency domain resolution f of a Real Fast Fourier Transform of the time-domain signal sampled at sampling rate F, and S>f * n, where n is at least 10,

(iii)   select S/n samples from the stored time domain signal and perform a Real Fast Fourier Transform (RFFT) on the selected samples to produce an RFFT signal,

(iv)   normalize the RFFT signal and calculate an average power for the RFFT signal,

(v)   place an event count in each of f selected-frequency event bins where a measured power at a corresponding selected frequency is greater than an average power times a value ε, where 0< ε<1 and is chosen such that a total number of counts placed in an event bin is between about 20-50% of a maximum possible bin counts in that bin,

(vi)   repeat steps (iii-v), and

(viii)   generate a histogram that shows, for each event bin f over a selected frequency range, a number of event counts in each bin.

5.   (Original) The apparatus of claim 4, wherein the machine readable code is further operable to, in (iv), place the normalized power value from the RFFT signal in f corresponding-frequency power bins, and in (viii), (a) divide accumulated values placed in

each of the f power bins by n, to yield an average power in each bin, and (b) display in the histogram, the average power in each bin.

6. (Original) The apparatus of claim 4, wherein the machine readable code is further operable to, in (viii), identify those bins in the histogram that have an event count above a given threshold and an average power.

7. (Amended) The apparatus of claim 1, wherein the source of <u>white or</u> Gaussian noise includes an adjustable-power <u>white or</u> Gaussian noise generator and a Helmholz coil which is contained within the magnetic electromagnetic shielding, and which receives a selected noise output signal from the noise generator in a range 100 mV to 1 V.

8. (Amended) The apparatus of claim 7, wherein the generator is designed to inject <u>white or</u> Gaussian noise into the sample at a frequency between DC and 2 kHz.

9. (Original) The apparatus of claim 1, wherein the detector is a second-derivative gradiometer which outputs a current signal, and a SQUID operatively connected to the gradiometer to convert the current signal to an amplified voltage signal.

10. (Amended) The apparatus of claim 9, wherein the container is an attenuation tube having a sample-holding region, a magnetic shielding cage surrounding the region, and a Faraday cage also surrounding the region, wherein the source of <u>white or</u> Gaussian noise includes a <u>white or</u> Gaussian noise generator and a Helmholz coil, wherein the Helmholtz coil is contained within the magnetic cage and the Faraday cage and receives a noise output signal from the noise generator, and wherein the apparatus further includes, for use in removing stationary noise components, a signal inverter operatively connected to the noise generator and to the SQUID, for receiving <u>white or</u> Gaussian noise from the noise generator and outputting into the SQUID, <u>white or</u> Gaussian noise in inverted form with respect to the <u>white or</u> Gaussian noise injected to the sample.

11.   (Amended) A method for interrogating a sample that exhibits low-frequency molecular motion, comprising:

placing the sample in a container having both magnetic and electromagnetic shielding,

(a)   injecting white or Gaussian noise into the sample at a selected noise amplitude;

(b)   recording an electromagnetic time-domain signal composed of sample source radiation superimposed on the injected white or Gaussian noise,

(c)   generating a spectral plot that contains, at a selected power setting of the white or Gaussian noise source, low-frequency, sample-dependent spectral components characteristic of the sample in a selected frequency range between 100 and 50 kHz, and

(d)   repeating (a)-(c) at different selected noise amplitudes until a plot showing a maximum or near maximum number of spectral components characteristic of the sample is generated., and

(e)   based on the plot showing the maximum or near maximum number of spectral components, characterizing the sample, or identifying components in the sample based on a comparison with one or more stored plots.

12.   (Original) The method of claim 11, wherein the generating includes (i) calculating a series of Fourier spectra of the time-domain signal over each of a plurality of defined time periods, in a selected frequency range between 100 Hz and 50 kHz, and (ii) averaging the Fourier spectra.

13.   (Original) The method of claim 12, wherein the calculating includes:

(i)   storing a time-domain signal of the sample over a sample-duration time T;

(ii)   selecting a sampling rate F for sampling the time-domain signal, where F* T is a total sample count S, F is approximately twice a frequency domain resolution f of a Real Fast Fourier Transform of the time-domain signal sampled at the sampling rate F, and S>f * n, where n is at least 10,

(iii)   selecting S/n samples from the stored time-domain signal and performing a Real Fast Fourier Transform (RFFT) on the selected samples to produce an RFFT signal,

(iv)   normalizing the RFFT signal and calculating an average power for the RFFT signal,

(v)   placing an event count in each of f selected-frequency event bins where a measured power at a corresponding selected frequency > average power * ε, where 0< ε<1 and is chosen such that a total number of counts placed in an event bin is between about 20-50% of a maximum possible bin count in that bin,

(vi)   repeating (iii) through (v), and

(viii)   generating a histogram that shows, for each event bin f over a selected frequency range, a number of event counts in each bin.

14.   (Original) The method of claim 13, which further includes, in (iv) placing the normalized power value from the RFFT signal in f corresponding-frequency power bins, and in (viii): (a) dividing accumulated values placed in each of the f power bins by n, to yield an average power in each bin, and (b) displaying on the histogram, the average power in each bin.

15.   (Original) The method of claim 14, which further includes identifying those bins in the histogram that have an event count above a given threshold and an average power.

16. (Original) A method of characterizing spectral emission features of a sample material, over a selected frequency range R, comprising:

selecting S/n samples from a time-domain signal and performing a Fast Fourier Transform (FFT) on the samples to produce an FFT signal, wherein F is a sampling rate for sampling the time-domain signal, where F* T is a total sample count S, F is greater than a frequency domain resolution f of the FFT of the time-domain signal sampled at the sampling rate F, and S>f * n, where n is at least 5;

calculating an average power for the FFT signal,

placing an event count in each of f selected-frequency event bins where the measured power at the corresponding selected frequency > average power * ε, where 0< ε<1 and is chosen such that the total number of counts placed in an event bin is between about 20-50% of maximum possible bin counts in that bin; and

generating a display that shows, for each event bin f over a selected frequency range, a number of event counts in each bin.

17. (Original) The method of claim 16, which further includes normalizing the FFT signal before calculating the average power, placing the normalized power value from the FFT in f corresponding-frequency power bins, dividing accumulated values placed in each of the f power bins by n to yield an average power in each bin, and displaying on a histogram the average power in each bin.

18. (Original) The method of claim 17, which further includes identifying those bins in the histogram that have an event count above a given threshold and an average power.

19. (Original) The method of claim 18, wherein R, expressed in Hz, is approximately equal to f, and the sample rate F, expressed in samples/second, is approximately 2f.

20. (Original) The method of claim 19, wherein the method detects low-frequency emission events related to molecular emissions in a sample, and wherein R includes at least the frequency range of 100 Hz to 5 kHz.

2l. – 41. (Canceled)